REMARKS

Favorable reconsideration, reexamination, and allowance of the present patent application are respectfully requested in view of the foregoing amendments and the following remarks. The foregoing amendments are fully supported by the specification and original claims, at least, on pages 9-40.

Personal Interview

Applicant and the undersigned wish to thank Ms. Nguyen for the courteous and productive interview conducted on 16 January 2007 with the inventor, Dr. Kiril Pandelisev, and Applicant's representatives Shelly Cermak and Radhika Raju. Because Applicant was not relieved of the duty under 37 C.F.R. § 1.33(b) of providing a summary of the arguments presented during that interview, Applicant provides the following comments.

Dr. Pandelisev generally explained one aspect of the subject matter described in this application, to wit, that forming a wafer boat out of a material which has higher purity and has thermal properties that are closely matched with, or the same as, those of the wafer material itself, can be very advantageous. Dr. Pandelisev discussed the fact that, for example, different coefficients of thermal expansion and heat capacity, between the boat and wafer materials, can result in degraded deposition patterns of material to the wafer itself, which can result in defective chips. Dr. Pandelisev also presented experimental data showing iron (Fe) and other contamination, which are standard problems with SiC wafer boats. To combat this problem, Dr. Pandelisev explained that selection of particular high purity materials, both for their thermal characteristics as well as their relative ease of forming a boat preform, can reduce or eliminate these deleterious effects. Furthermore, as explained by Dr. Pandelisev, a number of the materials described and claimed in this application can be formed using methods not heretofore possible, such as by extrusion, pressing, powder deposition, and molding, which can avoid another problem plaguing the industry: the introduction of impurities from glues and other such materials which have been used to join together parts of the wafer environment, when exposed to the harsh

treatments which are part of wafer processing.

Rejection under 35 U.S.C. § 102

In the Office Action, beginning at page 2, Claims 389-396, 399-401, and 404-408 were rejected for reciting subject matters that allegedly are anticipated by one or more prior art documents. More specifically, Claims 389-396, 399-401, and 405 were rejected under 35 U.S.C. § 102, as reciting subject matters that allegedly are anticipated by U.S. Patent No. 3,951,587, issued to Alliegro *et al.* ("Alliegro"). Claims 389, 392, 393, 399, 400, and 404-408 were rejected under 35 U.S.C. § 102, as reciting subject matters that allegedly are anticipated by U.S. Patent No. 5,776,391, issued to Sibley. Claims 389-396, 399-402, 404, and 405 were also rejected under 35 U.S.C. § 102, as reciting subject matters that allegedly are anticipated by U.S. Patent No. 5,942,454, issued to Nakayama *et al.* ("Nakayama"). Applicant respectfully requests reconsideration of these rejections.

This application describes devices and processes embodying principles of the present invention. As discussed above, the mismatch of materials, of which wafer boats are constructed and those of the wafers they hold, leads to many undesirable effects. Both the mismatched thermal characteristics of these materials, and the release of contaminants into the chip processing environment by the materials which are used to form current wafer boats, result in reject rates of the chips which are unnecessarily high. By presenting components of the chip handling and processing device which are formed of materials that have thermal characteristics that closely match, or are the same as, those of the wafer material itself, many of the problems arising from thermal mismatching can be ameliorated or avoided altogether. Furthermore, the industry practice of, essentially, 'gluing together' pieces to form wafer boats results in the presence of the 'glue' (or any of its components) in the wafer processing environment, which degrades and issues contaminants which are deposited onto the wafer, thus adding further to the degradation of the quality of the chips. By instead selecting materials that include high relative quantities of silicon, entire wafer boats and other subcomponents of the wafer processing

apparatus can be formed into complex shapes by any of a number of processes, including extrusion, pressing, powder deposition, and molding, among others. As discussed during the January 16th interview, currently available silicon itself has significantly lower concentrations of contaminants, and the addition of other materials to silicon can act as reinforcement to the silicon. The result can be devices which are both more closely thermally matched to the wafer material, which can be formed into completely from a single material without resort to 'glues' and the like, and which intrinsically have lower concentrations of contaminants to add to wafer processing.

Claim 389 relates to a wafer boat perform formed of a boat fabrication material selected from the group consisting of silicon, silicon compound comprising at least one silicon atom and in which silicon is a majority, silicon and germanium, $Si_{x1}Ge_{1-x1}$ solid solution, wherein $0 \leq X1 \leq 1$, silicon and silicon carbide $Si_{x2}(SiC)_{1-x2}$, wherein $0.3 \leq X2 \leq 1$, silicon and silicon dioxide $Si_{x3}(SiO_2)_{1-x3}$, wherein $0 < X3 < 1$, silicon and a ceramic and in which silicon is the majority material, silicon and an oxide $Si_{x4}(Oxide)_{1-x4}$, wherein $0 \leq X4 \leq 1$, silicon and a metal $Si_{x5}M_{1-x5}$, wherein $0 \leq X5 \leq 1$, silicon and a metal alloy $Si_{x6}A_{1-x6}$, wherein $0 \leq X5 \leq 1$, and combinations thereof.

Claim 393 relates to a process for fabrication of boat preforms, including providing a boat fabrication material selected from the group consisting of silicon, silicon and germanium, $Si_{x1}Ge_{1-x1}$ solid solution, wherein $0 \leq X1 \leq 1$, silicon and silicon carbide $Si_{x2}(SiC)_{1-x2}$, wherein $0.3 \leq X2 \leq 1$, silicon and silicon dioxide $Si_{x3}(SiO_2)_{1-x3}$, wherein $0 < X3 < 1$, silicon and a ceramic and in which silicon is the majority material, silicon and an oxide $Si_{x4}(Oxide)_{1-x4}$, wherein $0 \leq X4 \leq 1$, silicon and a metal $Si_{x5}M_{1-x5}$, wherein $0 \leq X5 \leq 1$, silicon and a metal alloy $Si_{x6}A_{1-x6}$, wherein $0 \leq X5 \leq 1$, and combinations thereof, and forming a wafer boat preform from the boat fabrication material.

Claim 399 relates to a process for fabrication of a member having the shape of a tube, a plate, or a rod, the process including providing a material selected from the group consisting of silicon, silicon and germanium, $Si_{x1}Ge_{1-x1}$ solid solution, wherein $0 \leq X1 \leq 1$, silicon and silicon carbide $Si_{x2}(SiC)_{1-x2}$, wherein $0.3 \leq X2 \leq 1$, silicon and silicon dioxide $Si_{x3}(SiO_2)_{1-x3}$, wherein

$0<X3<1$, silicon and a ceramic and in which silicon is the majority material, silicon and an oxide $Si_{x4}(Oxide)_{1-x4}$, wherein $0\leq X4\leq 1$, silicon and a metal $Si_{x5}M_{1-x5}$, wherein $0\leq X5\leq 1$, silicon and a metal alloy $Si_{x6}A_{1-x6}$, wherein $0\leq X5\leq 1$, and combinations thereof, and forming a tube, a plate, or a rod from the material.

The prior art, including *Alliegro*, *Sibley*, and *Nakayama*, fails to identically disclose the combinations of elements or steps recited in the pending claims.

Alliegro

Alliegro describes silicon carbide components of a wafer processing furnace, including a boat, which are impregnated with silicon metal. More specifically, *Alliegro* describes the silicon carbide being (as hoped by *Alliegro*) at least 99% pure and the silicon (again, as hoped by *Alliegro*) being 99.9% pure. See column 2, lines 30-36. Through *Alliegro*'s process, he states that: "[t]his will result in sintered shape [sic] becoming partially or wholly impregnated with silicon metal in the amount of from 5 to 30 percent by weight, depending on the degree of density of the sintered shape." Column 4, lines 63-67. Thus, *Alliegro* is entirely silent concerning the use of silicon in excess of 30%, as well as being silent about the use of any other materials with silicon for such devices or processes.

The Office Action alleges that *Alliegro* describes silicon or silicon carbide powder being used as the base material, citing to column 2, lines 33-36. As discussed above, however, *Alliegro* includes no such disclosure, instead instructing the reader to impregnate sintered silicon carbide with silicon metal. Certainly nowhere does *Alliegro* describe using pure silicon, or SiC-reinforced silicon members.

Sibley

Sibley describes a silicon carbide wafer carrier (see, e.g., Fig. 1) which, although having an interesting physical shape, suffers from the same drawbacks described above for such mismatched materials. *Sibley* mentions, at column 2, lines 58-64, a prior CVD silicon and

graphite cylinder, which is plainly not read on by the pending claims. Sibley also thus fails to disclose or describe a wafer boat preform formed of a compound as recited in the combinations of the pending claims, nor a process of forming a wafer boat preform including such materials.

Contrary to the statement in *Sibley*, wafer boats intended for vertical chamber processing, and other shapes, used today are impossible to fabricate using a CVD method. Furthermore, the fabrication cost for such a product is prohibitive, even for laboratory testing, much less production use. Additionally, *Sibley*'s wafer carrier is not made only by CVD processes; what is described is a pre-product that must be further machined, purified, etc.

Nakayama

Nakayama describes, like *Alliegro* and *Sibley*, SiC purification and silicon carbide wafer boats. Applicant notes that the Office Action alleges, at page 4, that *Nakayama* describes the use of pure silicon and the purposeful addition of certain dopants. The passage to which the Office Action makes reference, column 3, lines 23-24, states (in the entire paragraph):

> The silicon carbide powder thus prepared is mixed with water and an organic binder to obtain a slurry, and this slurry is cast in a resin mold, extruded by rolling or subjected to filter press or hydrostatic press to obtain a green product having a suitable shape depending upon the particular purpose. As the organic binder, a phenol resin, a polyvinyl acetate emulsion, an acrylic resin emulsion, a butyral resin, methylcellulose or wax may, for example, be preferably used. For this molding, it is important not to use a gypsum mold as in a conventional common method in order to avoid inclusion of calcium. However, a gypsum mold may be used if a coating film is formed on its surface to prevent contamination with impurities.

Nowhere does this passage mention pure silicon, contrary to the statement in the Office Action.

Nakayama does mention silicon, but only in the context of impregnation of silicon carbide with silicon (as described above in *Alliegro*), at column 3, lines 51-56:

> In the present invention, the sintered body as described above may be subjected to finish processing and may be used as it is for various parts. However, in a case where mechanical strength is particularly required, silicon may be impregnated to the obtained sintered body. Impregnation of silicon can be carried out by contacting molten silicon of

> a high purity to the surface of the sintered body at a temperature of from 1500 to 1800° C. to let it penetrate into the surface.

The Office Action further alleges that *Nakayama* describes the addition of certain materials; instead, *Nakayama* describes the levels of impurities that are achieved, not the level of other materials that are purposefully present in *Nakayama*'s silicon carbide. See column 3, lines 59-64:

> The silicon carbide product of the present invention is a silicon carbide product produced by the method as described above, wherein the content of iron is at most 1 ppm, the content of aluminum is at most 5 ppm, and the content of calcium is at most 3 ppm, as impurities.

Nakayama is focused on chemical processes for purification of SiC powder, the mixing of alpha and beta forms of SiC, and making and testing a SiC product. The 'purification' process of *Nakayama* is inapplicable to the presently claimed subject matter and, indeed, would damage components made according to principles of the present invention: Si is actually soluble in the acid mix described by *Nakayama*. Thus, *Nakayama*, like *Alliegro* and *Sibley*, also fails to identically disclose or describe a wafer boat preform, or processes of forming a preform or another shaped element, as recited in the combinations of the pending claims.

Conclusion

SiC is plagued by high levels of Fe and Ca. In the presentations made by Dr. Pandelisev during the personal interview, he showed not only the 'cold spots' created by the commonly commercially available wafer boats, but also places with increased levels of Fe. Those levels are plainly above acceptable levels for most chip fabrication processes.

For at least the foregoing reasons, Applicant respectfully submits that the subject matters of Claims 389-396, 399-401, and 404-408 are not anticipated by *Alliegro*, *Sibley*, or *Nakayama*, are therefore not unpatentable under 35 U.S.C. § 102, and therefore respectfully requests

withdrawal of the rejection thereof under 35 U.S.C. § 102.

Rejection under 35 U.S.C. § 103(a)

In the Office Action, beginning at page 5, Claims 397, 398, 402, and 403 were rejected under 35 U.S.C. § 103(a), as reciting subject matters that allegedly are obvious, and therefore allegedly unpatentable, over the disclosure of *Alliegro*, *Sibley* or *Nakayama* in view of the disclosure of U.S. Patent No. 4,620,839, issued to Moritoki *et al.* ("Moritoki"). Applicant respectfully requests reconsideration of this rejection.

Sibley used CVD on graphite; *Alliegro* impregnates SiC tubes (usually porous if only SiC is used); and *Nakayama* is focused on mixing alpha and beta SiC (by two different chemical processes), purifies SiC powder using acids, and then forms SiC pieces. *Alliegro*, *Sibley* and *Nakayama* each fail to identically disclose or describe each and every feature recited in the combinations of the pending claims, and *Moritoki* fails to make up for their deficiencies. Stated somewhat differently, even if *Moritoki* were combined with *Alliegro*, *Sibley* or *Nakayama* without the benefit of an impermissible hindsight reconstruction of Applicant's claimed invention from his own specification, the resulting hypothetical constructs would still not be read on by the pending claims, at least because *Moritoki* fails to disclose, describe, or suggest the differences between each of *Alliegro*, *Sibley* and *Nakayama* and the claimed combinations.

For at least the foregoing reasons, Applicant respectfully submits that the subject matters of Claims 397,398, 402, and 403, each taken as a whole, would not have been obvious to one of ordinary skill in the art at the time of Applicant's invention, are therefore not unpatentable under 35 U.S.C. § 103(a), and therefore respectfully requests withdrawal of the rejection thereof under 35 U.S.C. § 103(a).

New Claims

Claims 410-418 have been added, including a single independent claim. Claims 410-418 are allowable for at least the same reasons as Claims 389 *et sqq.*; an early indication of the

allowability of Claims 410-418 is earnestly solicited.

Conclusion

For at least the foregoing reasons, Applicant respectfully submits that this patent application is in condition for allowance. An early indication of the allowability of the patent application is therefore respectfully solicited.

If Examiner Nguyen believes that a telephone conference with the undersigned would expedite passage of the present patent application to issue, she is invited to call on the number below.

It is not believed that extensions of time are required, beyond those that may otherwise be provided for in accompanying documents. However, if additional extensions of time are necessary to prevent abandonment of this application, then such extensions of time are hereby petitioned under 37 C.F.R. § 1.136(a), and the Commissioner is hereby authorized to charge fees necessitated by this paper, and to credit all refunds and overpayments, to our Deposit Account 50-2821.

Respectfully submitted,

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